Manuscript accepted for publication in Drug and Alcohol Dependence on 12.01.18

Effectiveness of community psychosocial and pharmacological treatments for alcohol use disorder: A national observational, cohort study in England *

Amy Peacock[1,2], Brian Eastwood[3,4], Andrew Jones[5], Tim Millar[6], Patrick Horgan[3], Jonathan Knight[3], Kulvir Randhawa[3], Martin White[3], John Marsden[3,4] **

[1] National Drug and Alcohol Research Centre, University of New South Wales
[2] School of Medicine (Psychology), University of Tasmania
[3] Alcohol, Drug and Tobacco Division, Health and Wellbeing Directorate, Public Health England
[4] Institute of Psychiatry, Psychology and Neuroscience, King's College London
[5] Centre for Epidemiology, School of Health Sciences, The University of Manchester
[6] Centre for Mental Health and Safety, School of Health Sciences, The University of Manchester

Amy Peacock, Research Fellow, National Drug and Alcohol Research Centre, University of New South Wales, Randwick, Sydney 2052 New South Wales, Australia. Adjunct Fellow, School of Medicine (Psychology), University of Tasmania, Private Bag 30, Hobart, 7001 Tasmania

Brian Eastwood, Programme Manager, Evidence Application Team, Alcohol, Drugs and Tobacco Division, Health Improvement Directorate, Public Health England, 2nd Floor, Skipton House, 80 London Road, London SE1 6LH, United Kingdom

Andrew Jones, Senior Research Fellow, Centre for Epidemiology, Division of Psychology and Mental Health, School of Health Sciences, Faculty of Biology, Medicine, and Health, 4th Floor, Block C, Ellen Wilkinson Building, The University of Manchester, Oxford Road, Manchester, M13 9PL, United Kingdom

Tim Millar, Reader in Substance Use and Addictions, Centre for Mental Health and Safety, Division of Psychology and Mental Health, School of Health Sciences, Faculty of Biology, Medicine, and Health, 4th Floor, Block C, Ellen Wilkinson Building, The University of Manchester, Oxford Road, Manchester, M13 9PL, United Kingdom

Patrick Horgan, Senior Analyst, Alcohol, Drugs and Tobacco Division, Health Improvement Directorate, Public Health England, 2nd Floor, Skipton House, 80 London Road, London SE1 6LH, United Kingdom

Jonathon Knight, Director, Evidence Application Team, Alcohol, Drugs and Tobacco Division, Health and Wellbeing Directorate, Public Health England, 2nd Floor, Skipton House, 80 London Road, London SE1 6LH, United Kingdom

Kulvir Randhawa, Programme Manager, Alcohol, Drugs and Tobacco Division, Health Improvement Directorate, Public Health England, 2nd Floor, Skipton House, 80 London Road, London SE1 6LH, United Kingdom

Martin White, Programme Manager, Evidence Application Team, Alcohol, Drugs and Tobacco Division, Health Improvement Directorate, Public Health England, 2nd Floor, Skipton House, 80 London Road, London SE1 6LH, United Kingdom

John Marsden, Professor of Addiction Psychology, King's College London, Addictions Department, Box 48, Institute of Psychiatry, Psychology and Neuroscience, DeCrespigny Park, Denmark Hill, London SE5 8AF, United Kingdom.

Abstract: 250 words; Main text: 4,029 words; Tables: 4 in main text; Supplementary material: 1 table

* Supplementary material can be found by accessing the online version of this paper; ** Corresponding author. *E-mail address*: john.marsden@kcl.ac.uk

ABSTRACT

BACKGROUND: This was a national English observational cohort study using administrative data to estimate the effectiveness of community pharmacological and psychosocial treatment for alcohol use disorder (AUD).

METHODS: All adults commencing AUD treatment in the community reported to the National Drug Treatment Monitoring System (April 1 2014 to March 31 2015; N=52,499). Past 28 day admission drinking pattern included drinks per drinking day (DDD): 0 ('*Abstinent*'), 1-15 ('*Low-High*'), 16-30 ('*High-Extreme*') and over 30 DDD ('*Extreme*'). The primary outcome was successful completion of treatment within 12 months of commencement with no re-presentation (SCNR) in the subsequent six months, analysed by multi-level, mixed effects, multivariable logistic regression.

RESULTS: The majority reported DDD in the '*Low-High'* (n=17,698, 34%) and '*High-Extreme'* (n=21,383, 41%) range. Smaller proportions were categorised '*Extreme'* (n=7,759, 15%) and *'Abstinent'* (n=5,661, 11%). Three-fifths (58%) achieved SCNR. Predictors of SCNR were older age, black/minority ethnic group, employment, criminal justice system referral, and longer treatment exposure. Predictors of negative outcome were AUD treatment history, lower socio-economic status, housing problems, and '*Extreme'* drinking at admission. In addition to psychosocial interventions, pharmacological interventions and recovery support increased the likelihood of SCNR. Pharmacological treatment was only beneficial for the '*Low-High*' groups with recovery support.

CONCLUSIONS: Over half of all patients admitted for community AUD treatment in England are reported to successfully complete treatment within 12 months and are not re-admitted for further treatment in the following 6 months. Study findings underscore efforts to tailor AUD treatment to the severity of alcohol consumption and using recovery support.

KEYWORDS: alcohol; treatment; alcohol use disorder; psychosocial; pharmacological; recovery

1. Introduction

Reducing alcohol-related harms is a global public health priority (World Health Organisation, 2014). Alcohol consumption is linked to over 200 disease and injury conditions and implicated as a cause in 3.8% of all global deaths (Rehm et al., 2009). Each year, 3.6% of the global population (15-64 years) meet diagnostic criteria for alcohol use disorder (AUD; American Psychiatric Association, 2013) with higher rates estimated for Europe (5.5%) (Rehm et al., 2009). AUD is characterised as a chronic relapsing disorder, often associated with several presentations to treatment (Dennis et al., 2005).

Facilitating access to effective treatment is a key priority for most countries with developed healthcare systems. In the United Kingdom (UK), the National Institute for Health and Care Excellence (NICE; 2011) guidelines have identified a range of formal, randomised controlled trial (RCT) supported psychosocial and pharmacological interventions for the management of AUD (see Donoghue et al., 2015; Jonas et al., 2014; Martin and Rehm, 2012).

In England, public treatment systems for alcohol-related problems are commissioned by local government authorities in accordance with NICE guidance. Most AUD treatment is offered by National Health Service (NHS) and third sector services in primary and secondary care community/outpatient settings, the latter delivered by multi-disciplinary teams which typically include psychiatrists/physicians, psychiatric/general nurses, psychologists, social workers, and counsellors. There is also small number of inpatient and residential programs provided by the NHS and third sector.

Psychosocial interventions, delivered individually or in a group format, variously apply motivational, cognitive, behavioural, psychodynamic, family and social network methods. They provide access to general counselling, community support networks and 12-step groups to support abstinence or prevention of heavy drinking. Therapeutic targets vary and include resolving ambivalence about change and improving recognition of, and control over, alcohol conditioned cues, urges and emotions. These interventions vary in duration, from approximately 3 to 20 sessions according to the severity and complexity of the person's AUD and the methods involved.

Pharmacological interventions are used to help patients withdraw from alcohol and for relapse prevention. Withdrawal regimens, usually incorporating benzodiazepine medications, are typically for 7-10 days. Specific medications targeting the brain's reward and stress systems, including acamprosate, naltrexone, and nalmefene (Mason et al., 1999), help those who have stopped using alcohol maintain abstinence or prevent heavy drinking. These medications are usually provided for 6 months or longer with psychosocial support. In the context of continuing care, formal psychosocial

and pharmacological interventions may be delivered concurrently or sequentially within specific episodes.

In developed healthcare systems, AUD treatment plans incorporate information on the clinician history, patient preference, current clinical severity, case complexity, and service availability. In the UK, NICE (2011) guidelines are based on a delineation of treatment interventions according to level of consumption on a typical drinking day at assessment, as follows: people consuming ≤15 drinks per drinking day (DDD; one unit = 10mL, containing 8mg pure alcohol) are recommended for psychosocial interventions; those consuming 16-30 DDD should be assessed are recommended for pharmacological treatment to for assisted withdrawal, coupled with appropriate psychosocial interventions; and for those consuming 30 DDD, there should be assessment for a 24-hour medically supervised residential program.

Since 2005/06, the English National Drug Treatment Monitoring System (NDTMS; Public Health England, 2015b) has monitored access to treatment for drug use disorders and measuring associated outcomes. In 2008/09, NDTMS was enhanced to monitor outcomes from all public treatment services for AUD. Today, all operational public alcohol and drug treatment services who deliver treatment interventions report to the system and ~98% of patients consent to the use of their administrative and clinical data for local treatment system needs assessment and national research (Marsden et al., 2009; Marsden et al., 2012; White et al., 2015; Willey et al., 2016).

A crucial question for alcohol policy and public accountability is whether public treatment services for AUD are effective. There has been remarkably little research on this question in the UK or overseas. For several reasons, routine effectiveness in the clinic may differ to results from RCTs and systematic reviews. Clinical trials conducted in this area typically involve specified treatment protocols, delivered within a single setting to patients categorised by a set threshold of severity (usually with criteria imposed to minimise risk of poor response; Witkiewitz et al., 2015). Such restrictions may not apply to the general treatment population, who present with a wide range of clinical severity and health and social complexities. Understanding those characteristics which predict treatment outcomes for this diverse population is critical for targeting services, facilitating prognosis, and improving treatment outcomes (Adamson et al., 2009).

There has been no national study to date on the clinical effectiveness of community AUD treatment services in the UK, with previous reports focusing on treatment provision (Brennan et al., 2005) and recidivism (Willey et al., 2016). For England, we report on the clinical outcomes for AUD associated with pharmacological and psychosocial interventions.

2. Methods

2.1 Design

This was an observational, follow-up study of people accessing publicly-funded, community-based, treatment for AUD in England. A report on the effectiveness of residential treatments is reported elsewhere (Eastwood et al., under review). Data were collected from all community based treatment agencies providing structured psychosocial and pharmacological interventions for AUD and reporting to NDTMS (Public Health England, 2015b). The study included all 152 upper-tier local authorities within England, and all specialist AUD services within the National Health Service or third-sector reporting to the database. The study is reported according to the STROBE (and RECORD) guideline for cohort research (Benchimol et al., 2015).

2.2 Patient and treatment information

NDTMS records were accessed on patient-demographic, behavioural, clinical and treatment outcome variables for each episode of treatment, including the dates of starting and finishing AUD interventions (Public Health England, 2015a, b). Reflecting national reporting standards (Public Health England, 2015b), and utilising a pre-existing variable in the database, individual treatment episodes were concatenated into 'treatment journeys', whereby multiple episodes (community-based or residential program) are subsumed under a single journey.

AUD intervention episodes were allocated to the same treatment journey if fewer than 21 days elapsed between the date of ending one intervention and the date of starting a subsequent one. In this way, a treatment journey for a patient could comprise a single intervention episode; concurrent episodes provided by more than one agency; or a continuing care package of consecutive episodes provided by one or more service providers.

2.3 Study cohort

The study population was adults (aged ≥18 years) who commenced community treatment for primary AUD between 1 April 2014 and 31 March 2015 (N=54,354). Patients were not included in the study cohort if they: (1) reported problematic use of other substances at assessment; (2) had missing information on DDD at both triage and treatment admission; or (3) had missing information on clinical status at discharge were not considered for inclusion. Following removal of 1,425 cases who were assessed but then received no treatment, the analysis cohort comprised 52,499 individuals.

Analyses were based on the patients' first treatment journey during the period (hereafter 'index journey'). The observation period commenced from the date of starting community-based structured treatment and ended either six months after the date of discharge from the index journey, if discharge

occurred within 12 months of starting treatment; or 12 months after starting treatment if the patient was not yet discharged (the latter group was excluded from analysis of the primary outcome).

2.4 Outcome measure

A commonly used measure of treatment outcome is the proportion of patients treated who complete treatment successfully (i.e., discharge from treatment based on reduced alcohol use or abstinence, depending on treatment goals; Alterman et al., 2001). Whilst this outcome is associated with reduced alcohol use and improved social outcomes (e.g., employment, offending) (Finigan, 1996), it does not identify the extent to which the treatment effect is enduring beyond the clinical setting, critical given high rates of relapse.

The primary outcome measure for the current study was defined as successful completion of treatment within 12 months of admission for community-based treatment, with no re-presentation for AUD in the subsequent six months (i.e. 'successful completion and no representation' [SCNR]). Successful treatment was defined as the patient being discharged having completed their care plan, abstinent (or no heavy drinking), and with no re-presentation to any service for further AUD treatment within six months (Eastwood et al., 2017; Public Health England, 2016). In this categorisation, no re-presentation is proxy indicator of remission.

All treatment journeys were categorised according to clinical assessment of patients' discharge status, as follows: (1) successfully completed treatment within 12 months (i.e., client no longer requires structured drug treatment interventions and is judged by the clinician not to be using heroin (or any other opioids) or crack cocaine or any other illicit drug); (2) retained in the same treatment journey at 12 months from entry; (3) withdrawn from index treatment journey within 12 months of entry due to unsuccessful transfer between service providers; or (4) treatment terminated due to incarceration or patient dropped out of or died during treatment (Public Health England, 2015b).

2.5 Covariates

Following our general evaluation approach (Willey et al., 2016), the analysis included patient socio-demographics; indicators of clinical severity/case complexity; and summary measures of treatment journey exposure. Patient-level measures were recorded at triage assessment at the first admission to the index journey. The following covariates were included.

2.5.1 Socio-demographics

Analyses were adjusted for: age (years), gender, ethnic origin, housing problems (homeless, in short-term hostel provision, or at risk of eviction in the past 28 days); and employment (whether in paid

work in past 28 days). Analyses were also adjusted for an indicator of social deprivation, imputed by assigning patients to their electoral ward of residence, based on the partial postal code recorded by NDTMS, categorised according to the Department for Communities and Local Government ward-level Indices of Multiple Deprivation (IMD; Department for Communities and Local Government, 2015). If the partial postcode could be located in more than one electoral ward the median IMD score for these was assigned. If partial postcode was missing the IMD score for the first treatment service address within the index treatment journey was assigned. Following UK local government reporting convention (Public Health England, 2015a), IMD scores were grouped by quintile.

2.5.2 Clinical characteristics

Analyses were adjusted based on patients' self-report of the number of days on which they consumed alcohol; and the number of standard DDD in the previous 28 days (Tuithof et al., 2014). These were recorded via the Treatment Outcomes Profile (TOP) (Marsden et al., 2008). TOP is the national clinical outcome measure in NDTMS, administered as a face-to-face structured clinical interview, with timeline follow-back technique to maximise recall accuracy (Sobell et al., 1988). Reflecting NICE (2011) guidelines for treatment provision based on alcohol use on treatment admission, DDD were categorised as: *abstinent* (i.e. zero drinks in the previous 28 days); *low to high* (1 to 15 DDD); *high to severe* (16 to 30 DDD); and *extreme* (≥ 31 DDD). We also adjusted for source of treatment referral (health service; self/friend/family; criminal justice system), and whether the patient had previously received AUD treatment as recorded in NDTMS (i.e., from 2006 onwards).

2.5.4 Treatment exposure

Analyses were adjusted based on the combination of treatment type exposure within the index treatment journey, as follows: (1) psychosocial treatment only; (2) psychosocial and pharmacological treatment; (3) psychosocial treatment and recovery support; and (4) psychosocial and pharmacological treatment and recovery support. Recovery support was via direct treatment service provision or referral, including facilitated access to mutual aid; peer support involvement, family, parenting, support groups; housing, employment, education and training support; and complementary therapies. The number of days in receipt of psychosocial and pharmacological interventions was right censored at 365 days, computed using the triage and discharge date for the specific intervention.

2.6 Statistical Analysis

In this national treatment population study, with a hierarchical design (i.e. participants grouped in treatment services) our statistical power concerns reflected control of clustering effects and minimising bias of coefficient estimates in the models. We note that multi-level simulation studies have concluded that power is increased by adding groups rather than the number of cases per group.

In the event, our sample (636 AUD services) well exceeded the minimum recommended for multi-level designs (e.g. 50 groups for random effects models; Maas and Hox, 2005).

All analyses were conducted in Stata v13.1 (Stata version 13.1; Stata Corporation, College Station, TX, USA). All estimates were computed with associated 95% confidence intervals (95% CI). For the DDD measure, a multi-level, multinomial logistic regression approach (command: *mlogit*) with robust standard errors was used to adjust for clustering of participants within treatment services. Analysis of the SCNR outcome excluded people who did not leave treatment within 12 months after treatment initiation.

Where data for employment, housing status, days of alcohol use and DDD were missing from standard assessment procedures, these were replaced with data from the first TOP interview where available. Missing values were observed for housing (n=483), employment (n=1,154), ethnic origin (n=1,898) and referral source (n=174). With no contrary evidence that data loss was missing-at-random (Little and Little, 2002), multiple imputation via chained equations was used (Stata command: *mi: impute chained*). An all-case multivariate logistic model was run to check on potential bias and loss of precision (Sterne et al., 2009). To achieve a relative efficiency above 98% (Rubin, 1987) and to ensure that reduction in power was less than 1% (Graham et al., 2007), 20 datasets of probabilistic values were created, each analysed separately, and then combined using Rubin's rules.

Multi-level, mixed effects, multivariable logistic models were used to assess the SCNR outcome (command *meqrlogit* with 7 integration points) with patient-level covariates included as fixed effects. It was anticipated that the likelihood of SCNR, and predictors of SCNR, would vary by baseline severity given that baseline alcohol consumption is prognostic factor for treatment outcomes (Adamson et al., 2009). Consequently, sub-analyses were conducted where predictors of SCNR were studied by drinking severity at admission (indexed by DDD, see section 2.5.2). The '*High-Extreme group*' served as referent for total sample analyses as the group whose alcohol use most closely aligned with NICE guidelines (National Institute for Health and Care Excellence, 2011) indicating delivery of community-based treatment. Simulation studies suggest a minimum of 10 or more events per covariate in logistic regression analyses; this criterion was satisfied in the current analyses (Peduzzi et al., 1996). Models based on imputation are reported in-text; complete-case analyses are available in supplementary materials.

3. Results

3.1 Socio-Demographic/Clinical Characteristics

The majority of patients were male (62%) and the median age was 45 years (IQR 36-53) (**Table 1**). Two-fifths (38%) had received structured AUD treatment prior to their index journey.

For the majority, DDD status was categorised as '*Low-High*' (34%) or '*High-Extreme'* (41%). Of the remainder, 15% were designated '*Extreme'* and 11% as *'Abstinent'*. The '*Extreme group'* were more likely to be male and younger, to report housing problems, current unemployment, and an AUD treatment history, and live in areas with the greatest socio-economic disadvantage, and the *'Low-High group'* the inverse, compared to the *'High-Extreme group'* (**Table 2**).

The *'Abstinent'* group were less likely to be male and in paid employment, and more likely to identify as black or minority ethnic group relative to the *'High-Extreme group'.* Notably, all three groups were more likely to report criminal justice referral to treatment relative to the *'High-Extreme group'.*

3.2 Treatment Exposure and Status

The cohort accessed 636 specialist community treatment services (median of 27.5 participants per service; IQR 4, 115). In their index journey, 59% received structured psychosocial treatment only; 26% received psychosocial treatment with recovery support; 10% received psychosocial and pharmacological interventions; and 5% received all three (**Table 1**). The '*Abstinent group'* and '*Low-High group'* were less likely to receive pharmacological treatment, and the '*Extreme group'* was more likely to receive all three interventions, relative to the *'High-Extreme group'*. Median total duration of treatment exposure was equivalent to more than four months (18 weeks). Half of the sample (54%) successfully completed treatment within 12 months (**Table 3**). This was inversely related to DDD, ranging from 61.1% of the '*Abstinent group'* to 44.8% of the *'Extreme group'*.

3.3 SCNR outcome

Half (58%) of those who left treatment within 12 months of commencement (i.e., excluding those still in treatment) achieved the SCNR outcome (**Table 3**). This was more likely among those who were: older; identified as black or other ethnic minority; in paid employment; referred to treatment by criminal justice services; in receipt of longer treatment exposure; and who received other interventions in addition to psychosocial intervention (**Table 4**). Specifically, the addition of pharmacological treatment to psychosocial intervention increased the likelihood of this outcome by 35%, addition of recovery support by 80%, and addition of both pharmacological intervention and recovery support by 147%. This outcome was less likely for those who: lived in areas of greatest socio-economic disadvantage; reported housing problems; and reported previous AUD treatment.

Relative to the '*High-Extreme group',* the '*Abstinent group*' and '*Low-High group*' had greater adjusted odds (1.80, 95% CI 1.67 to 1.94 and OR 1.31, 95% CI 1.25 to 1.37, respectively), and the '*Extreme group*' lower adjusted odds (0.82, 95% CI 0.78 to 0.88) of attaining the SCNR outcome.

Testing the model for each DDD group showed similar associations with covariates and the primary outcome, with the exception that provision of pharmacological intervention with psychosocial intervention was not associated with SCNR for the '*Abstinent group*' and '*Low-High group*', although the latter group was advantaged when delivered alongside recovery support.

3.3.1 Sensitivity analysis

The associations identified in the imputed models were generally evident in complete-case analyses (**Table S1**). As a check on potential selection effects risking a positive bias in treatment response, we ran a fixed effects logit model and compared with a Heckman selection model. Parameter estimates were essentially the same between the two models (all z-values were approximately of the same direction, magnitude and statistical significance).

We also calculated the E-value. The E-value is an estimate of the minimum strength of association that an unmeasured confounder would need to account for a treatment-outcome association, conditional on the included covariates (VanderWeele and Ding, 2017). An observed AOR of 1.35 for psychosocial and psychosocial intervention, 1.80 for psychosocial interventions and recovery support, and 2.47 for all three interventions could be explained away by an unmeasured confounder that was associated with both the treatment and the outcome by a OR of 2.04 (95%CI 1.81-2.30), 3.00 (95%CI 2.77-3.23), and 4.38 (3.85-4.98), respectively, above and beyond the measured confounders, but weaker confounding could not do so. The confidence intervals could be moved to include the null by an unmeasured confounder that was associated with both the treatment and the outcome by an OR of 1.81, 2.77, and 3.85 each, above and beyond the measured confounders, but weaker confounding could not do so.

4 Discussion

The current national study provides a unique opportunity to assess community-based intervention outcomes for the heterogeneous AUD population. Using the NICE (2011) guidelines, we categorised patients according to severity of alcohol use in order to test for differences between these groups. The DDD groups differed socio-demographically, particularly in reference to previously identified risk factors for poorer treatment outcomes (Adamson et al., 2009). Specifically, the '*Extreme group'* were more likely to be male, younger, live in areas with the greatest socio-economic disadvantage, report lower rates of employment, and higher rates of homelessness and past AUD treatment involvement, relative to the '*High-Extreme group*'. In contrast, the '*Low-High group'* were more likely to report factors predictive of positive treatment outcomes (e.g., female, older age, lower socio-economic disadvantage, higher rates of employment) relative to the '*High-Extreme group*'.

Less clear is where the *'Abstinent group'* fit in terms of previously identified risk factors for poorer treatment outcomes. Similar to the '*High-Extreme group'* in socio-economic status and AUD treatment history, this group were also more likely to be female (correlate of positive treatment outcome), younger, and with lower rates of employment (correlates of poorer treatment outcomes) (Adamson et al., 2009). Possible explanations for this group include entry into treatment following incarceration, noting that this group had the highest rate of referral from criminal justice services, or abstinence as a requirement for commencing acamprosate and naltrexone, although only one-tenth of this group received pharmacotherapy.

Over half the sample successfully completed treatment; one-quarter ceased treatment, and one-tenth were retained in treatment at 12 months. The lack of national treatment monitoring systems in other countries (or lack of reporting on these systems) makes cross-national comparison of treatment outcomes challenging. Yet, 65% of closed treatment episodes in Australia in 2015-16 where alcohol was the principal drug of concern were coded as 'expected cessation' (defined as successful completion or cessation at expiation or mutual agreement), similar to that recorded in NDTMS (Australian Institute of Health and Welfare, 2017). Successful treatment completion is linked with greater likelihood of abstinence, lower risk of relapse, and lower engagement in crime. However, given the recovery-relapse cycle often associated with AUD, we believe the SCNR outcome is a more sensitive indicator of treatment effectiveness in terms of remission, and more meaningful in terms of economic and service utilisation burden. The current study showed that patients were more likely to achieve the SCNR outcome if they were older, identified as black or other ethnic minority, engaged in paid employment, and engaged in treatment for longer. Conversely, patients were less likely to achieve the SCNR outcome if they lived in areas with greatest socio-economic disadvantage, reported housing problems or had an AUD treatment history. These characteristics have previously been identified as predictors of treatment retention (Brorson et al., 2013; Elbreder et al., 2011; Haug and Schaub, 2016) with the exception of ethnicity. Ethnicity has been identified as a poor predictor of treatment outcome, although the association is not routinely reported (Adamson et al., 2009). Further exploration as to why individuals identifying as black or other ethnic minority have similar (or, in this instance, better) treatment outcomes despite displaying greater pre-treatment risk factors for poorer outcomes is warranted (Tonigan, 2003).

The likelihood of SCNR outcome also increased when pharmacological and recovery support interventions were received in addition to psychosocial treatment. These findings reinforce treatment guidelines recommending the delivery of psychosocial intervention alongside pharmacological treatment (Haber et al., 2009; National Institute for Health and Care Excellence, 2011; Substance Abuse and Mental Health Services Administration and National Institute on Alcohol Abuse and Alcoholism, 2015). Most importantly, this study highlights the possible benefits of recovery support:

the addition of recovery support to psychosocial intervention had a stronger association with SCNR than the addition of pharmacological intervention, with the strongest association observed with delivery of all three interventions.

It is important to note though that the association between intervention type and the SCNR outcome differed according to DDD severity. Positive predictors of the SCNR outcome were: the addition of recovery support to psychosocial treatment for the '*Abstinent group'*; the addition of recovery support (with or without pharmacological treatment) for the '*Low-High group'*; and the addition of pharmacological treatment and/or recovery support for the '*High-Extreme group'* and '*Extreme group'* (largest magnitude association in the presence of all three interventions). We could not determine which pharmacological therapies were being delivered, thus precluding conclusions regarding relative efficacy. However, the stronger magnitude association of pharmacotherapy provision and SCNR amongst those groups with greater severity of DDD supports use of pharmacotherapy for those presenting with moderate to severe dependence (National Institute for Health and Care Excellence, 2011). Further, the positive association between recovery support and SCNR reinforces the importance of continuing care (e.g., recovery check-ups, facilitate access to mutual aid) and an emphasis on the broader wellbeing of the individual (e.g., provision of family, housing, education and employment support) (Laudet, 2008).

AUD is a chronic condition, often cyclical in nature (Scott et al., 2005a; Scott et al., 2005b). Study of long-term recovery has revealed various protective factors, including self-confidence, coping strategies, health, financial resources, and quality of family, friend, and work relationships, associated with positive AUD outcomes up to 15 years subsequent to treatment (Moos and Moos, 2006). Given the remission-relapse cycle and often co-occurring risk factors for poorer quality of life (e.g., unemployment, homelessness), these findings highlight the necessity of acknowledging case complexity and providing supports to improve broader aspects of functioning. We would advocate for further work disentangling the specific forms of recovery support which are efficacious, taking into consideration independent and interactive effects of interventions, to inform targeted delivery. In addition, it will be important to establish whether these associations hold when predicting re-presentation to treatment over a longer duration than six months post-discharge.

4.1 Strengths and Limitations

Representation of individuals seeking AUD treatment across the continuum of DDD severity is a strength of this study, indicating fulfilment of the above aim of assessing outcomes across a diverse population of alcohol consumers. However, several study limitations should be noted. Firstly, the sample was restricted to those who reported only problematic alcohol use. Whilst existing research indicates high comorbidity between AUD and other substance disorders (Stinson et al., 2005), annual

2014/15 NDTMS data (Public Health England, 2015a) indicates that alcohol only patients formed 30% of the total treatment population, and patients with comorbid alcohol and non-opiate problematic use only 10%. Related to this, severity of use was only indexed by self-reported DDD, meaning that assessment was not via established, psychometrically valid scales and may be subject to possible recall and social desirability bias.

Secondly, NDTMS does not include other possible correlates of treatment outcomes, such as other indicators of social stability and support (e.g., marital status, family structure), self-efficacy, personality traits (e.g., impulsivity), treatment goals, and specific co-existing mental health conditions (Adamson et al., 2009), and these are recognised a potential unmeasured confounders. Third, we were not able to link treatment records to national deaths registry or the national prisons system, meaning that we could not censor data for barriers to treatment re-presentation. Given that only 0.2% and 0.9% of the sample ceased treatment within 12 months of admission due to incarceration and mortality, respectively, we do not anticipate that the rate of SCNR would decrease substantially accounting for these factors. Fourth, privately-funded treatment may not be captured in NDTMS, leading to possible under-ascertainment of six-month re-presentation following conclusion of the index journey. Finally, we should note that the whilst our definition of SCNR matched national reporting standards (Public Health England, 2015b), further work using a lengthier period to identify relapse (≥12 months) could elucidate longer-term treatment outcomes.

4.2 Conclusion

The lower likelihood of achieving SCNR among patients with greater DDD at commencement highlights the need for additional supports for these patients, particularly given the interplay of additional risk factors (e.g., homelessness, unemployment) amongst this group. Provision of pharmacological intervention and/or recovery support enhanced the likelihood of achieving SCNR, relative to psychosocial intervention alone, although the former was only beneficial for those presenting with greater severity alcohol use at commencement. Whilst the relative efficacy of the various forms of recovery support and pharmacological intervention requires exploration, these findings support the need for a multi-faceted approach to treatment, according to severity of use, with a focus on maintaining remission and improving broader aspects of wellbeing.

Appendix A. Supplementary materials

Supplementary material related to this article can be found, in the online version, at: XXXXXXX.

5 References

Adamson, S.J., Sellman, J.D., Frampton, C.M., 2009. Patient predictors of alcohol treatment outcome: a systematic review. Journal of Substance Abuse Treatment 36, 75-86.

Alterman, A.I., Langenbucher, J., Morrison, R.L., 2001. State-level treatment outcome studies using administrative databases. Evaluation Review 25, 162-183.

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). American Psychiatric Association.

Australian Institute of Health and Welfare, 2017. Alcohol and other drug treatment services in Australia 2015–16. Drug treatment series no 29 Cat no HSE 187. AIHW, Canberra.

Benchimol, E.I., Smeeth, L., Guttmann, A., Harron, K., Moher, D., Petersen, I., Sørensen, H.T., von Elm, E., Langan, S.M., Committee, R.W., 2015. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. PLoS Medicine 12, e1001885.

Brennan, P.L., Schutte, K.K., Moos, R.H., 2005. Pain and use of alcohol to manage pain prevalence and 3-year outcomes among older problem and non-problem drinkers. Addiction 100, 777-786.

Brorson, H.H., Ajo Arnevik, E., Rand-Hendriksen, K., Duckert, F., 2013. Drop-out from addiction treatment: A systematic review of risk factors. Clinical Psychology Review 33, 1010-1024.

Dennis, M.L., Scott, C.K., Funk, R., Foss, M.A., 2005. The duration and correlates of addiction and treatment careers. Journal of substance abuse treatment 28, S51-S62.
Department for Communities and Local Government, 2015. The English Index of Multiple Deprivation.

(IMD) 2015. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015.accessed on 29th June 2017>.

Donoghue, K., Elzerbi, C., Saunders, R., Whittington, C., Pilling, S., Drummond, C., 2015. The efficacy of acamprosate and naltrexone in the treatment of alcohol dependence, Europe versus the rest of the world: a meta-analysis. Addiction 110, 920-930.

Eastwood, B., Peacock, A., Millar, T., Jones, A., Knight, J., Horgan, P., Lowden, T., Willey, P., Marsden, J., under review. Effectiveness of inpatient withdrawal and residential rehabilitation treatment for alcohol use disorder: A national observational, cohort study in England.

Eastwood, B., Strang, J., Marsden, J., 2017. Effectiveness of treatment for opioid use disorder: A national, five-year, prospective, observational study in England. Drug and Alcohol Dependence 176, 139-147.

Elbreder, M.F., e Silva, R.d.S., Pillon, S.C., Laranjeira, R., 2011. Alcohol dependence: Analysis of factors associated with retention of patients in outpatient treatment. Alcohol and Alcoholism 46, 74-76.

Finigan, M., 1996. Societal outcomes and cost savings of drug and alcohol treatment in the State of Oregon. . Exploring the Key Components of Drug Courts. Office of Alcohol and Drug Abuse Programs, Portland.

Graham, J.W., Olchowski, A.E., Gilreath, T.D., 2007. How many imputations are really needed? Some practical clarifications of multiple imputation theory. Prevention Science 8, 206-213.

Haber, P., Lintzeris, N., Proude, E., Lopatko, O., 2009. Guidelines for the treatment of alcohol problems. Australian Government Department of Health and Ageing, Sydney.

Haug, S., Schaub, M.P., 2016. Treatment outcome, treatment retention, and their predictors among clients of five outpatient alcohol treatment centres in Switzerland. BMC Public Health 16, 581.

Jonas, D.E., Amick, H.R., Feltner, C., et al., 2014. Pharmacotherapy for adults with alcohol use disorders in outpatient settings: A systematic review and meta-analysis. Journal of the American Medical Association 311, 1889-1900.

Laudet, A.B., 2008. The Road to Recovery: Where are we going and how do we get there? Empirically-driven conclusions and future directions for service development and research. Substance Use & Misuse 43, 2001-2020.

Little, R.J.A., Little, D.B., 2002. Statistical Analysis with Missing Data. Wiley, New York.

Maas, C.J., Hox, J.J., 2005. Sufficient sample sizes for multilevel modeling. Methodology 1, 86-92.

Marsden, J., Eastwood, B., Bradbury, C., Dale-Perera, A., Farrell, M., Hammond, P., Knight, J., Randhawa, K., Wright, C., Group, N.D.T.M.S.O.S., 2009. Effectiveness of community treatments for heroin and crack cocaine addiction in England: a prospective, in-treatment cohort study. The Lancet 374, 1262-1270.

Marsden, J., Eastwood, B., Jones, H., Bradbury, C., Hickman, M., Knight, J., Randhawa, K., White, M., 2012. Risk adjustment of heroin treatment outcomes for comparative performance assessment in England. Addiction 107, 2161-2172.

Marsden, J., Farrell, M., Bradbury, C., Dale-Perera, A., Eastwood, B., Roxburgh, M., Taylor, S., 2008. Development of the treatment outcomes profile. Addiction 103, 1450-1460.

Martin, G.W., Rehm, J., 2012. The effectiveness of psychosocial modalities in the treatment of alcohol problems in adults: a review of the evidence. The Canadian Journal of Psychiatry 57, 350-358.

Mason, B.J., Salvato, F.R., Williams, L.D., Ritvo, E.C., Cutler, R.B., 1999. A double-blind, placebo-controlled study of oral nalmefene for alcohol dependence. Archives of General Psychiatry 56, 719-724.

Moos, R.H., Moos, B.S., 2006. Rates and predictors of relapse after natural and treated remission from alcohol use disorders. Addiction 101, 212-222.

National Institute for Health and Care Excellence, 2011. Alcohol-use disorders: diagnosis, assessment and management of harmful drinking and alcohol dependence. https://www.nice.org.uk/guidance/cg115.accessed on 29th June 2017>.

Peduzzi, P., Concato, J., Kemper, E., Holford, T.R., Feinstein, A.R., 1996. A simulation study of the number of events per variable in logistic regression analysis. Journal of Clinical Epidemiology 49, 1373-1379.

Public Health England, 2015a. Adult substance misuse statistics from the National Drug Treatment Monitoring System (NDTMS): 1 April 2014 to 31 March 2015. Public Health England, London.

Public Health England, 2015b. National Drug Treatment Monitoring System (NDTMS): Adult drug treatment business definition. Public Health England, London.

Public Health England, 2016. Public Health Outcomes Framework: 2.15iii Successful completion of alcohol treatment. Public Health England, London.

Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., Patra, J., 2009. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. Lancet 373, 2223-2233.

Rubin, D.B., 1987. Multiple imputation for non-response in surveys. John Wiley and Sons, New York.

Scott, C.K., Dennis, M.L., Foss, M.A., 2005a. Utilizing recovery management checkups to shorten the cycle of relapse, treatment reentry, and recovery. Drug and Alcohol Dependence 78, 325-338.

Scott, C.K., Foss, M.A., Dennis, M.L., 2005b. Pathways in the relapse—treatment—recovery cycle over 3 years. Journal of Substance Abuse Treatment 28, S63-S72.

Sobell, L.C., Sobell, M.B., Leo, G.I., Cancilla, A., 1988. Reliability of a Timeline Method: Assessing normal drinkers' reports of recent drinking and a comparative evaluation across several populations. British Journal of Addiction 83, 393-402.

Sterne, J.A., White, I.R., Carlin, J.B., Spratt, M., Royston, P., Kenward, M.G., Wood, A.M., Carpenter, J.R., 2009. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. British Medical Journal 338, b2393.

Stinson, F.S., Grant, B.F., Dawson, D.A., Ruan, W.J., Huang, B., Saha, T., 2005. Comorbidity between DSM-IV alcohol and specific drug use disorders in the United States: results from

the National Epidemiologic Survey on Alcohol and Related Conditions. Drug and Alcohol Dependence 80, 105-116.

Substance Abuse and Mental Health Services Administration and National Institute on Alcohol Abuse and Alcoholism, 2015. Medication for the treatment of alcohol use disorder: A brief guide. US Department of Health and Human Services, Rockville.

Tonigan, J.S., 2003. Project match treatment participation and outcome by self-reported ethnicity. Alcoholism: Clinical and Experimental Research 27, 1340-1344.

Tuithof, M., ten Have, M., van den Brink, W., Vollebergh, W., de Graaf, R., 2014. Alcohol consumption and symptoms as predictors for relapse of DSM-5 alcohol use disorder. Drug and alcohol dependence 140, 85-91.

VanderWeele, T.J., Ding, P., 2017. Sensitivity analysis in observational research: introducing the E-value. Annals of Internal Medicine 167, 268-274.

White, M., Burton, R., Darke, S., Eastwood, B., Knight, J., Millar, T., Musto, V., Marsden, J., 2015. Fatal opioid poisoning: a counterfactual model to estimate the preventive effect of treatment for opioid use disorder in England. Addiction 110, 1321-1329.

Willey, H., Eastwood, B., Gee, I.L., Marsden, J., 2016. Is treatment for alcohol use disorder associated with reductions in criminal offending? A national data linkage cohort study in England. Drug and alcohol dependence 161, 67-76.

Witkiewitz, K., Finney, J.W., Harris, A.H., Kivlahan, D.R., Kranzler, H.R., 2015. Recommendations for the design and analysis of treatment trials for alcohol use disorders. Alcoholism: Clinical and Experimental Research 39, 1557-1570.

World Health Organisation, 2014. Global status report on alcohol and health 2014. World Health Organisation, Geneva.